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THERMAL CONDUCTIVITY MEASUREMENTS OF TWO PAPERBOARD MATERIALS

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to

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U. S. DEPARTMENT OF COMMERCE
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1. INTRODUCTION

At the request of the Office of The Quartermaster General, reference file QMCRX 400.112, letter dated March 15, 1954, thermal conductivity measurements were made on two paperboard materials to determine their insulation value.

2. MATERIALS

Sample No.	Test Specimen	Description
1	Two 6x6x1 inch specimens each consisting of 11 layers of paperboard. Average thickness of paperboard 0.089 inch.	Paperboard material manufactured by Gaylord Container Corporation, St. Louis, Mo.
2	Two 6x6x1 inch specimens each consisting of 10 pieces of paperboard. Average thickness of paperboard 0.100 inch.	Paperboard material manufactured by the Container Corporation of America, Chicago, Ill.

3. TEST METHOD AND PROCEDURE

The thermal conductivity of the specimens was measured in an 8-inch guarded hot-plate apparatus conforming with the requirements of Fed. Spec. LLL-F-321b and of ASTM C177-45.

Specimens were made by piling together enough plies of the paperboard material to obtain a thickness of approximately one-inch. The material was tested as received without drying. In the case of sample No. 2, the waxed surfaces of the paperboard faced the cold plate during the test. No wax was observed on any of the faces of Sample No. 1.

4. RESULTS

A summary of the test data is given in Table 1 and a plot of thermal conductivity versus mean temperature is shown in Figure 1. Since the lowest mean temperature at which a determination could be made was about 40°F, extrapolation of the data by straight lines to lower temperatures involves some approximation. However, it is believed that within the accuracy required for practical purposes, such extrapolation would be permissible.

TABLE 1

Specimen	Mean temp. of spec. °F	Density as tested lb/ft	Thickness as tested inch	Temp. gradient in spec. deg F/inch	Thermal Conductivity Btu/hr ft^2 (deg F/inch)	Thermal Conductance of one ply Btu/hr ft^2 (deg F)
1 (11 plies)	68.9	43.1	0.977	43.2	0.560	6.31
	40.4	43.1	.978	43.0	.538	6.05
2 (10 plies)	70.0	46.9	.997	44.3	.625	6.27
	40.8	46.9	.997	42.2	.593	5.95

TABLE I

Specimen	Mean temp. of spec. °F	Density as tested lb/ft³	Thickness as tested inch	Temp. gradient in spec. deg F/inch	Thermal conductivity Btu/hr ft °F (deg F/inch)	Thermal conductance of spec. Btu/hr ft² (deg F)
1 (12 plies)	68.9	43.1	0.977	43.2	0.550	0.37
	140.4	43.1	.978	43.0	.758	0.05
2 (10 plies)	70.0	46.3	.994	44.3	.695	0.27
	140.8	47.9	.997	45.2	.823	5.95

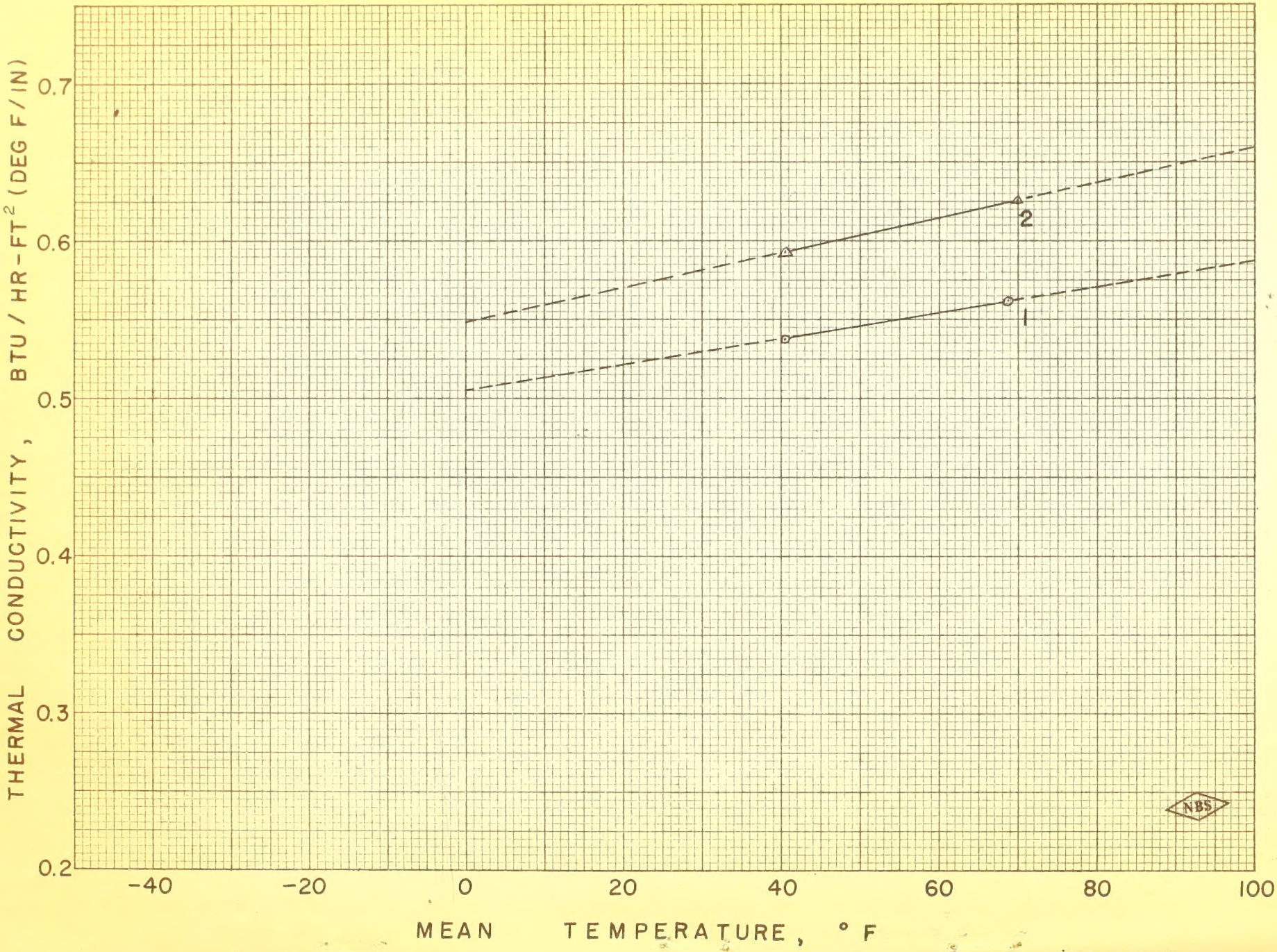
THERMAL CONDUCTIVITY, BTU / HR-FT² (DEG F / IN)
0.7
0.6
0.5
0.4
0.3
0.2
-40
-20
0
20
40
60
80
100
MEAN TEMPERATURE, ° F
2
1
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FIGURE 1